What is claimed is:

CLAIM 1. A portable coordinate measurement machine (CMM) for measuring the position of an object in a selected volume, comprising:

a manually positionable articulated arm having opposed first and second ends, said arm including a plurality of joints;

a measurement probe attached to a first end of said articulated arm;

an electronic circuit which receives the position signals from transducers in said arm and provides a digital coordinate corresponding to the position of the probe in a selected volume; and

wherein at least one of said joints further comprise;

a periodic pattern of a measurable characteristic;

at least one read head spaced from and in communication with said pattern;

said pattern and said read head being positioned within said joint so as to be rotatable with respect to each other; and

at least one sensor which measures relative movement in said articulated arm with respect to said at least one read head so as to improve the measurement accuracy of said at least one read head.

CLAIM 2. The CMM of claim 1 wherein:

said at least one read head is in axial alignment with said at least one sensor.

CLAIM 3. The CMM of claim 1 wherein said at least one sensor comprises a plurality of spaced sensors which measure displacement.

CLAIM 4. The CMM of claim 1 wherein said at least one sensor comprises a sensor which measures displacement.

CLAIM 5. The CMM of claim 4 including at least one sensor for measuring X-axis displacement of said pattern.

CLAIM 6. The CMM of claim 4 including at least one sensor for measuring Y-axis displacement of said pattern.

CLAIM 7. The CMM of claim 5 including at least one sensor for measuring Y-axis displacement of said pattern.

CLAIM 8. The CMM of claim 1 wherein said at least one joint includes a shaft surrounded, at least in part, by a housing, said shaft and said housing being adapted to rotate relative to one another, and wherein said at least one sensor includes at least one sensor for measuring relative movement between said shaft and said housing.

CLAIM 9. The CMM of claim 8 including a plurality of sensors for measuring relative movement between said shaft and said housing.

CLAIM 10. The CMM of claim 8 wherein said shaft is rotatable.

CLAIM 11. The CMM of claim 9 wherein said shaft is rotatable.

CLAIM 12. The CMM of claim 11 wherein said at least one sensor includes:

at least two sensors for measuring relative movement of said shaft including a first sensor for measuring X axis displacement and a second sensor for measuring Y axis displacement.

CLAIM 13. The CMM of claim 12 wherein said plurality of sensors for measuring relative movement of said shaft further include a third sensor for measuring X axis rotation, a fourth sensor for measuring Y axis rotation and a fifth sensor for measuring Z axis displacement.

CLAIM 14. The CMM of claim 12 wherein said at least one read head measures Z axis rotation of said shaft.

CLAIM 15. The CMM of claim 13 wherein said at least one read head measures Z axis rotation of said shaft.

CLAIM 16. The CMM of claim 13 wherein said third, fourth and fifth sensors are positioned at about 120 degrees with respect to each other.

CLAIM 17 The CMM of claim 8 including at least five sensors which, together with said read head, measure at least six degrees of freedom of said shaft.

CLAIM 18. The CMM of claim 1 wherein said relative movement is caused by deformation to said arm.

CLAIM 19. The CMM of claim 18 wherein said relative movement is caused by deformation of bearings in said joints.

CLAIM 20. The CMM of claim 1 wherein said at least one sensor includes:

at least two sensors which measure movement in said periodic pattern with respect to said at least one read head.

CLAIM 21. The CMM of claim 20 wherein:

said at least two sensors are positioned at about 90 degrees to each other.

CLAIM 22. The CMM of claim 21 wherein:

said at least two sensors comprise proximity sensors.

CLAIM 23. The CMM of claim 1 wherein:

said pattern comprises an optical fringe pattern; and

said at least one read head comprises an optical read head.

CLAIM 24. The CMM of claim 23 wherein:

said optical fringe pattern is disposed on an optical encoder disk.

CLAIM 25. The CMM of claim 23 wherein said communication comprises:

said read head detecting the interference between diffraction orders to produce sinusoidal signals from said read head inserted in said fringe pattern, said sinusoidal signals being electronically interpolated to detect displacement.

CLAIM 26. The CMM of claim 1 wherein:

said pattern of a measurable characteristic is at least one of the characteristics selected from the group consisting of reflectivity, opacity, magnetic field, capacitance, inductance and surface roughness.

CLAIM 27. The CMM of claim 1 wherein said joints comprise long joints for swiveling motion and short joints for hinged motion.

CLAIM 28. The CMM of claim 27 including three joint pairs, each joint pair comprising a long joint and a short joint.

CLAIM 29. The CMM of claim 1 wherein said joints are arranged in the joint configurations selected from the group consisting of 2-2-2, 2-1-2, 2-2-3, and 2-1-3.

CLAIM 30. The CMM of claim 1 wherein:

said pattern is rotatable with respect to said at least one read head; and

said at least one read head is stationary with respect to said pattern.

CLAIM 31. The CMM of claim 1 wherein:

said pattern is stationary with respect to said at least one read head; and

said at least one read head is rotatable with respect to said pattern.

CLAIM 32. The CMM of claim 1 wherein said joint further comprises:

a first and second housing, and a rotatable shaft extending from said second housing into said first housing;

a bearing disposed between said shaft and said first housing permitting said rotatable shaft to rotate within said first housing;

said pattern being attached to said rotatable shaft;

said at least one read head being fixed within said first housing such that rotation of the first housing with respect to the second housing causes said at least one read head to move relative to said pattern.

CLAIM 33. The CMM of claim 32 wherein:

said pattern is attached directly to said shaft.

CLAIM 34 The CMM of claim 1 wherein said at least one joint comprises:

a first housing;

a second housing;

a rotatable shaft fixed to said second housing and extending into said first housing;

at least one bearing supported within said first housing and supporting said rotatable shaft for rotation about its axis; wherein one of said pattern and said at least one read head is fixed to an end of said shaft and the other of said pattern and said at least one read head is fixed within said first housing.

CLAIM 35. The CMM of claim 4 wherein said at least one sensor comprises a proximity sensor.

CLAIM 36. The CMM of claim 35 wherein said proximity sensor measures movement using at least one of Hall effects, magneto effects, resistive effects, capacitance and optics.

CLAIM 37. A portable coordinate measurement machine (CMM) for measuring the position of an object in a selected volume, comprising:

a manually positionable articulated arm having opposed first and second ends, said arm including a plurality of joints;

a measurement probe attached to a first end of said articulated arm;

an electronic circuit which receives the position signals from transducers in said arm and provides a digital coordinate corresponding to the position of the probe in a selected volume; and

wherein at least one of said joints further comprise;

a rotatable shaft surrounded, at least in part, by a housing, said shaft and said housing being adapted to rotate relative to one another;

a periodic pattern of a measurable characteristic;

at least one read head spaced from and in communication with said pattern;

said pattern and said read head being positioned within said joint so as to be rotatable with respect to each other; and

a plurality of displacement sensors which measure relative movement between said shaft and said housing, said relative movement measurement being used to improve the measurement accuracy of said at least one read head.

CLAIM 38. The CMM of claim 37 including at least five sensors which, together with said read head, measure at least six degrees of freedom of said shaft.